

Evaluation of Protocols for Determining Asphalt Binder Content and PG Characteristics

Research Objectives

- Determine within-lab and between-lab variability of solvent extraction, ignition and asphalt analyzer procedures used to quantify asphalt content.
- Evaluate the variability in PG properties of extracted binder after recovery.
- Provide recommendations for improving WisDOT material and mix design standards.

Research Benefits

- Determined within-lab and between-lab variability of each asphalt content test.
- Recommended including ignition and asphalt analyzer tests in WisDOT specifications.
- Offered correction factors for ignition testing and tolerance adjustments to extraction testing to improve accuracy.

Background

Accurate determination of asphalt content is critical to ensuring the quality of asphalt mixes used in Wisconsin's road projects. The two most-common methods for determining asphalt content are the American Association of State Highway and Transportation Officials (AASHTO) solvent extraction and ignition tests. These procedures are well established; however, their accuracies are sensitive to variations in materials and high recycled binder content mixes commonly used in Wisconsin. Therefore, an evaluation is needed to assess within-lab and between-lab testing variability.

The main objectives of this research were to evaluate solvent extraction, ignition and asphalt analyzer test procedures; determine tolerances between methods; and modify WisDOT material and mix standards. The research team also evaluated the variability of the performance grade (PG) properties of extracted binder after recovery.

Methodology

The National Center for Asphalt Technology (NCAT) and several Wisconsin labs evaluated asphalt analyzer, AASHTO T 164 method A (centrifuge extraction) and method B (reflux extraction) and AASHTO T 308 ignition tests. The labs performed each of these tests on eight mixes, including virgin mixes and mixes with various recycled binder contents, containing four Wisconsin aggregates to quantify the variability in the determination of their asphalt content. NCAT also conducted centrifuge, reflux, and ignition tests on two sources of reclaimed asphalt pavement (RAP) and one source of reclaimed asphalt shingles (RAS).



Unburned asphalt remains after an ignition test performed at 800°F for RAS material.

Test results were analyzed per ASTM E 691 and ASTM C 802. Within-lab and between-lab variability for each test procedure was developed for Wisconsin materials and compared to the current AASHTO standards.

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“This study advances both WisDOT’s and our contractor’s ability to verify the asphalt binder content in our mixtures, which will ensure more durable pavements.”
– Dan Kopacz,
WisDOT

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[WisDOT Research website.](#)

Results

The differences between actual and measured asphalt content were: 0.21% for centrifuge extraction; 0.17% for the asphalt analyzer; 0.14% for reflux extraction; and 0.05% for ignition, when correction factors were used. Asphalt analyzer and centrifuge extraction results indicate that solvents may be unable to remove all binder from mixes.

The within-lab and between-lab standard deviations and acceptable ranges of the asphalt analyzer, centrifuge extraction and reflux extraction tests met AASHTO T 164 requirements. The ignition method’s within-lab and between-lab standard deviations and acceptable ranges exceeded AASHTO T 308 specifications. RAP did not affect the results of any test, and RAS only affected ignition results.

Ignition test results showed that most aggregates included in the study had high mass loss. Tests conducted at 800°F proved to be effective in reducing the variability in measured asphalt content. The lower temperature resulted in less loss due to aggregate burning and thus reduced the asphalt correction factors for asphalt mixes. However, for RAS material, when tests were conducted at 800°F, there was some unburned asphalt left in the residue that was not observed when tests were conducted at 900°F.

For the materials used in this study, extraction method and solvent type did not have a significant effect on the PG properties of recovered binders. Further research is needed to quantify interactions between solvents and modified binders.

Recommendations for Implementation

WisDOT specifications for testing recovered asphaltic binder currently only allow for the AASHTO T 164 centrifuge extraction method. The research team recommends WisDOT also allow asphalt analyzer and ignition tests. The asphalt analyzer results showed the lowest standard deviations of all test procedures and were similar to the centrifuge extraction results. The ignition test also yielded accurate asphalt content results when correction factors were applied.

If ignition testing is incorporated, it should be conducted at the proper temperature dependent on aggregate-mass loss rather than the standard 1,000°F.

This brief summarizes Project 0092-16-02,
“Asphalt Binder Extraction Protocol for Determining Amount & PG
Characteristics of Binders Recovered from Asphalt Mixtures”
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